

**TOSHIBA**



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# **ASD TORQUE CONTROL MANUAL**

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# **ASD Torque Control Manual**

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**Document Number: 58696-000**

**Date: May, 2008**

# Introduction

The **ASD Torque Control Manual** explains the concepts behind torque control and details the relevant parameter settings for using the Toshiba 9-Series ASD in torque control mode. Please read the entire manual carefully before attempting to operate your ASD in torque control mode. Contact your Toshiba sales representative for additional information.

## Important Notice

The instructions contained in this manual are not intended to cover all details or variations in equipment types. Nor may it provide for every possible contingency concerning the installation, operation, or maintenance of this equipment. Contact your Toshiba sales representative for additional information.

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Toshiba's Customer Support Center can be contacted to obtain help in resolving any **Adjustable Speed Drive** system problem that you may experience or to provide application information.

The center is open from 8 a.m. to 5 p.m. (CST), Monday through Friday. The Support Center's toll free number is US (800) 231-1412/Fax (713) 937-9349 — Canada (800) 527-1204.

You may also contact Toshiba by writing to:

Toshiba International Corporation  
13131 West Little York Road  
Houston, Texas 77041-9990  
Attn: ASD Product Manager.

For further information on Toshiba's products and services, please visit our website at [www.toshiba.com/ind/](http://www.toshiba.com/ind/).

# About This Manual

This manual was written by the Toshiba Technical Publications Group. This group is tasked with providing technical documentation for the **ASD Torque Control Manual**. Every effort has been made to provide accurate and concise information to you, our customer.

At Toshiba we're continuously searching for better ways to meet the constantly changing needs of our customers. E-mail your comments, questions, or concerns about this publication to [Technical-Publications-Dept@tic.toshiba.com](mailto:Technical-Publications-Dept@tic.toshiba.com).

## Manual's Purpose and Scope

This manual provides information on how to safely implement Torque Control with the ASD. The information provided in this manual is applicable to ASD Torque Control only.

This manual provides configuration information for controlling the ASD via Torque Control.

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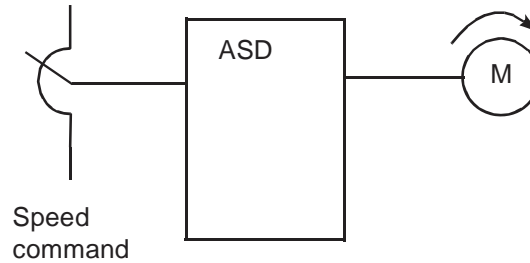




# Torque versus Speed Control

The Toshiba ASD can be configured to operate in either speed control or torque control mode.

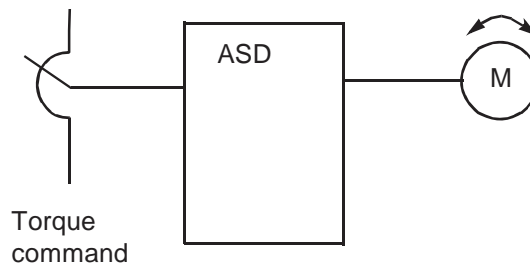
Speed control mode detects variance from a reference frequency, and adjusts the ASD output frequency and voltage to match the measured frequency to the reference frequency.



Torque control mode detects variance from a referenced motor load, and adjusts the output frequency and voltage to match the measured load to the reference load.

Torque control of a motor is done in order to maintain a constant tension (load) on a motor. Examples using torque control mode are accelerating/decelerating an elevator or running a winding machine.

The ASD can be set for either unidirectional or bidirectional motor rotation as required by the application.



The ASD can be configured to use either of two torque control methods:

- Sensorless vector control relies on the internal programming of ASD.
- Vector control with sensor requires the ASD be equipped with one of the encoder feedback options (Toshiba Part No. VEC004Z through 007Z).

For applications requiring very accurate torque control use the vector control with sensor method. Set parameter **F015** to **8: PG Vector Feedback Control (Speed/Torque)**.

## Torque Control Parameter Settings

Use the following parameters to configure and operate the ASD in torque control mode.

- **F015** — V/f pattern
- **F111** to **F118** — Input terminal function selection (use one of them)
- **F420** — Torque command selection

# V/f Pattern Selection

Set parameter **F015 – V/f Pattern** for torque control by selecting one of two options:

- Set **F015** to **4: Sensorless Vector Control** if not using a motor frequency feedback sensor.
- Set **F015** to **8: PG Vector Feedback Control** if using a motor frequency feedback sensor.

**Table 1. Parameter F015 selection options.**

Parameter	Function	Adjustment range	Default setting
<b>F015</b>	V/f control mode selection	0: Constant torque characteristics	0: Constant torque characteristics
		1: Square reduction torque control characteristics	
		2: Automatic torque boost	
		3: Sensorless vector control (Speed)	
		4: Sensorless vector control (Speed/Torque) <sup>1, 3</sup>	
		5: V/f 5-point setting	
		6: PM control	
		7: PG feedback vector control (Speed)	
		8: PG feedback vector control (Speed/Torque) <sup>1, 2</sup>	

1 – Torque control (vector control) requires setting motor-related constants F014, F405 – F407 and F409. Refer to [Setting Motor Constants on pg. 7](#) and motor constants in the ASD instruction manual.

2 – Use two-phase input type sensor when torque control is operated in vector control with sensor mode.

3 – Use vector control with a two-phase sensor for applications requiring “forward power running ↔ reverse regeneration,” and “forward regeneration ↔ reverse power running.” Sensorless vector control does not support these functions.

# Torque Control Selection

Torque control selection can be made by any of the following methods:

- Discrete input terminal signal
- Parameter commands via the EOI (Electronic Operator Interface)
- Communication via DeviceNet, PROFIBUS, etc.

## Torque Control Selection with Discrete Input Terminal Signal

This method assigns the torque control switching signal to an ASD discrete input terminal. Switch between torque control and speed control by closing or opening the switch.

The default factory setting for parameter **F117 – Input terminal 7 (S3) selection** is input setting **14: Preset Speed Command 3**.

To use S3 for control switching, change parameter **F117 – Input terminal 7 (S3) selection** input setting to **112: Control switching (speed/torque)**.

Parameter	Function	Adjustment range	Setting
<b>F117</b>	Input terminal function selection 7(S3)	0 to 135	112: Control switching (speed/torque)

**Note:** If the S3 terminal is already in use, assign the function to an unused discrete input terminal.

The terminal function can be set to always-torque by setting parameter **F110 – Always ON** to **112: Control Switching**.

Figure 1. Control Switching.

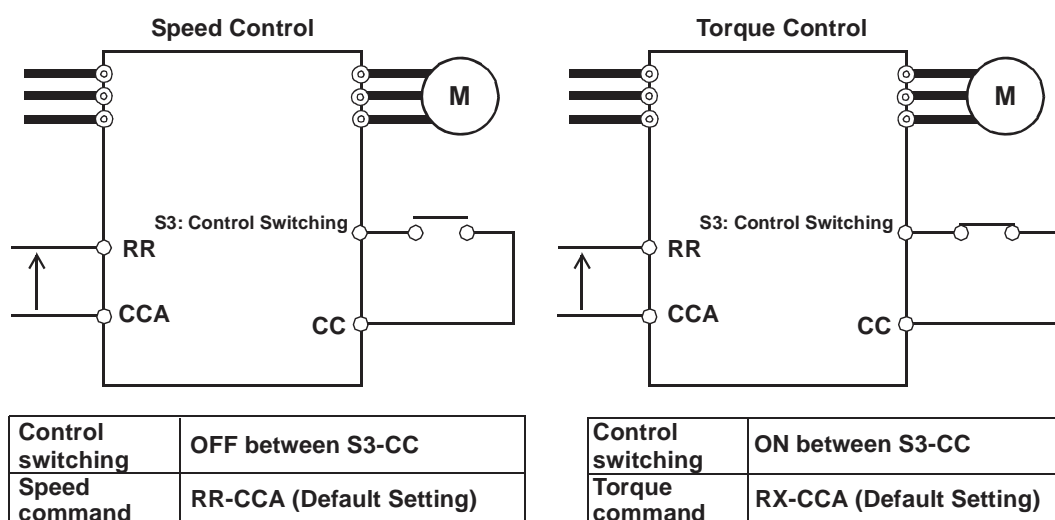


Table 2. Command Set with F420 Enabled (Default setting: RX input).

Parameter	Function	Adjustment range	Default setting
<b>F420</b>	Torque command selection	1: V/I (voltage/current input) 2: RR (Potentiometer/voltage input) 3: RX (voltage input) 4: Keypad input <sup>1</sup> 5: RS485 2-wire 6: RS485 4-wire 7: Communications option board 8: RX2/AI1 (differential current input)	3: RX (voltage input)

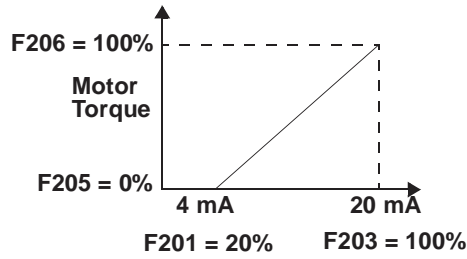
**Note:** Select **4: Keypad input** to activate the control panel torque reference **F725**.

Figure 2. Three control modes.

1.) Current signal 4 – 20 mA mA DC

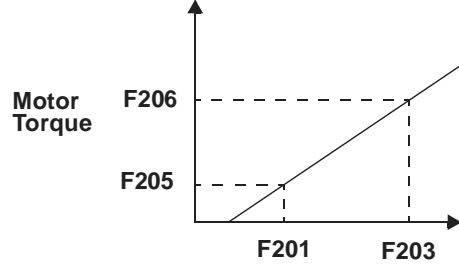
V/I input F108 (analog input V/I current/voltage switching) = 1 (current input)

Default Setting



\* Torque produced: 0% at 4 mA DC, and 100% at 20 mA DC.

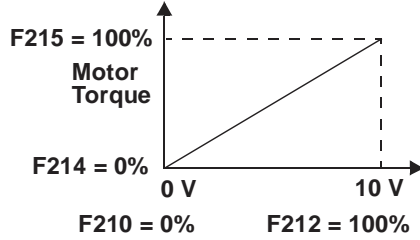
Arbitrary Setting



The relationship between the torque command and the motor torque can be changed: F201 and F203 settings 20% and 80% correspond to currents of 8 and 16 mA DC, respectively.

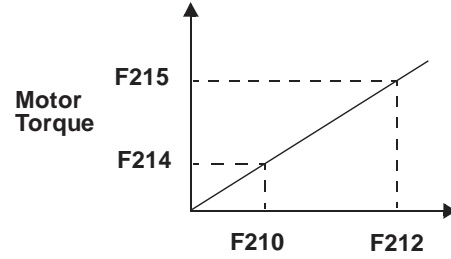
2) Voltage signal 0 – 10 Vdc using RR input.

Default Setting



\* Torque produced: 0% at 0 V DC, and 100% at 10 V DC.

Arbitrary Setting

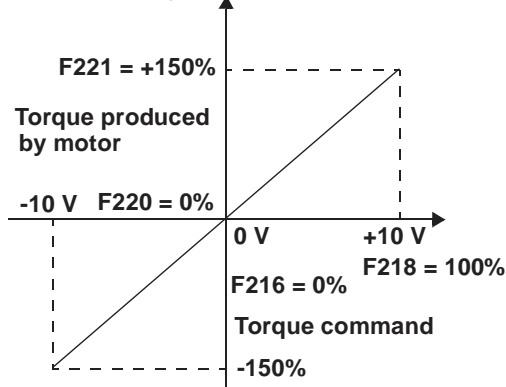


The relationship between the torque command and the motor torque can be changed: F210 and F212 settings 20% and 70% correspond to voltages of 2 and 7 V DC, respectively.

Figure 2. Three control modes. (Continued)

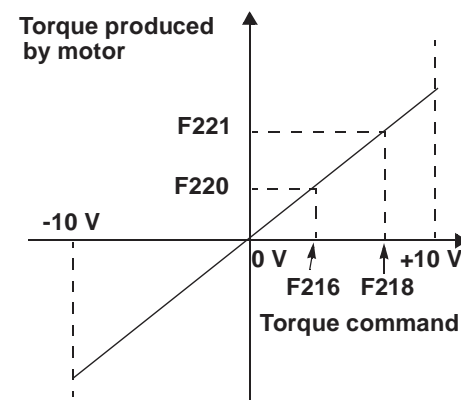
### 3) Voltage signal 0 to $\pm 10$ Vdc at RX input

#### Default Setting



\* Torque produced: -150% at -10 V DC, 0% at 0 V DC, and 150% at 10 V DC.

#### Arbitrary Setting



The relationship between the torque command and the motor torque can be changed: F216 and F218 settings for 20% and 80% correspond to 2 and 8 V DC, respectively.

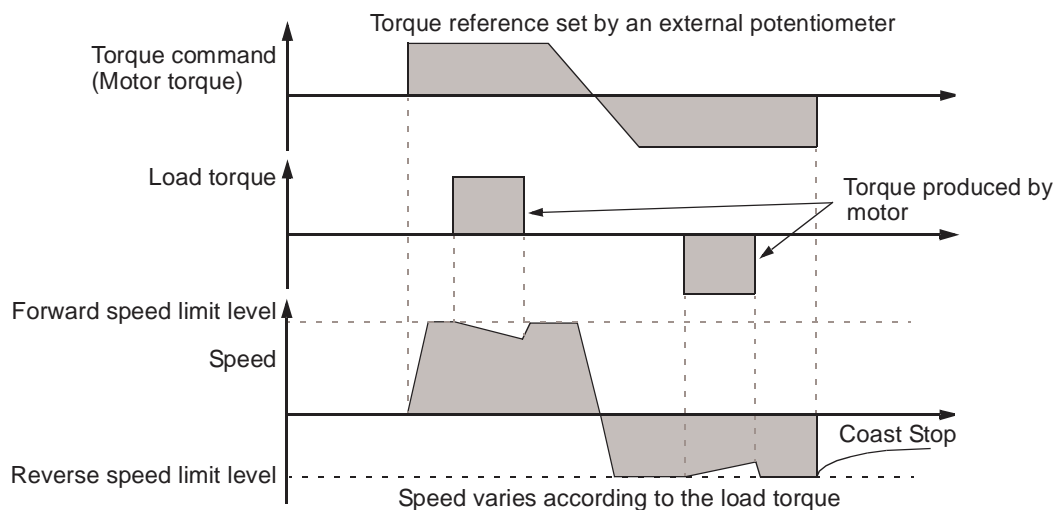
## Torque Control Mode Speed Limits

Speed limit parameters limit the rise in the output frequency of the ASD due to a drop in load torque when operating in torque control mode.

Speed limits can be set either at a specific frequency, or by specifying a center frequency with a  $\pm$  frequency bandwidth.

### Set Speed Limits with External Input Signals

Figure 3. Torque Reference Set by an External Potentiometer.



### Set Speed Limits with EOI (Electronic Operator Interface)

The speed limits can be set by entering the forward/reverse speed limit level parameters **F426/F428**.

Set Forward Speed Limit Level:

**F425 – Forward Speed Limit Input selection:** Set to **4: F426 setting**.

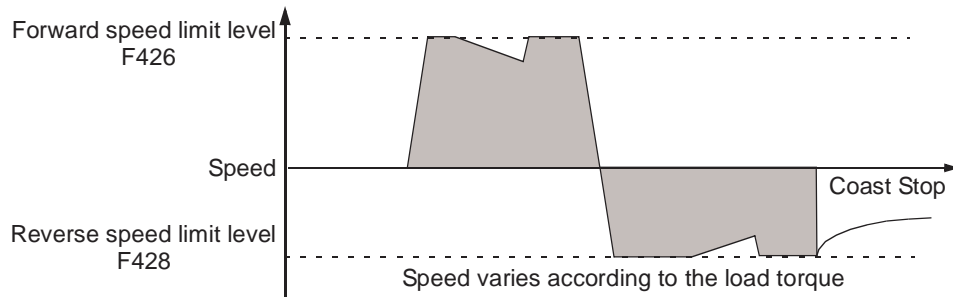
**F426 – Forward Speed Limit Input Level:** Set desired forward speed limit level.

Set Reverse Speed Limit Level:

**F427 – Reverse Speed Limit Input selection:** Set to **4: F428 setting**.

**F428 – Reverse Speed Limit Input level:** Set desired reverse speed limit level.

Figure 4. Torque Reference Set with the Operator Interface.



### Set Speed Limits with External Signal

Speed limits can be adjusted by changing the selected external signals.

**F425 – Forward Speed Limit Input** and **F427 – Reverse Speed Limit Input** are used to enable/disable setting the speed limit input with either an external discrete input or an internal preset value.

Table 3. External Signals.

Control signals	External Input	Signal Range	F425/F427 Settings
Voltage signals	RR-CC	0 to 10 V	2: RR
	RX-CC	0 to $\pm 10$ V	3: RX
	V/I-CC	0 to 10 V	1: V/I
Current signals	V/I-CC	4(0) to 20 mA	1: V/I
Disabled	–	–	0: Disabled
F426/F428 Setting	None	0.0 Hz – F012	4: F426 Setting/4: F428 Setting

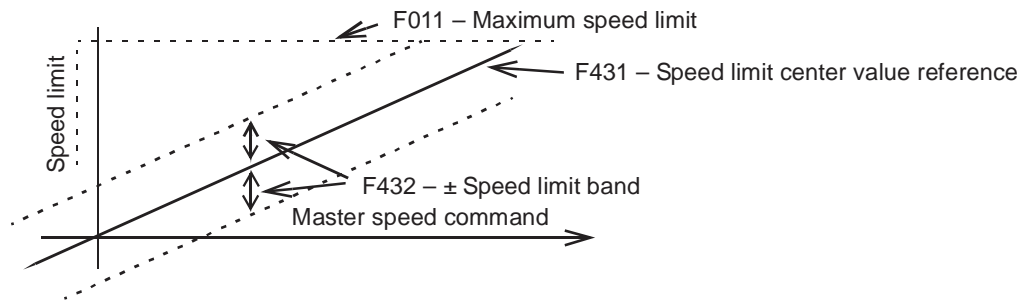
## Set Speed Limit using a Center Value and Limit Band

A speed limit can be set by entering the center value speed limit and speed limit band.

**Table 4. Parameters for Speed Limit With the Center Value Specified by a Reference.**

Parameter	Function	Adjustment range	Default setting
F430	Speed limit (torque = 0) center value reference	0: Disabled 1: V/I (voltage/current input) 2: RR (potentiometer/voltage input) 3: RX (voltage input) 4: F431 enabled	0: Disabled
F431	Speed limit (torque = 0) center value	0.0 Hz to F011	0.0
F432	Speed limit (torque = 0) band	0.0 Hz to F011	0.0

**Figure 5. Speed limit set with center value and limit band.**



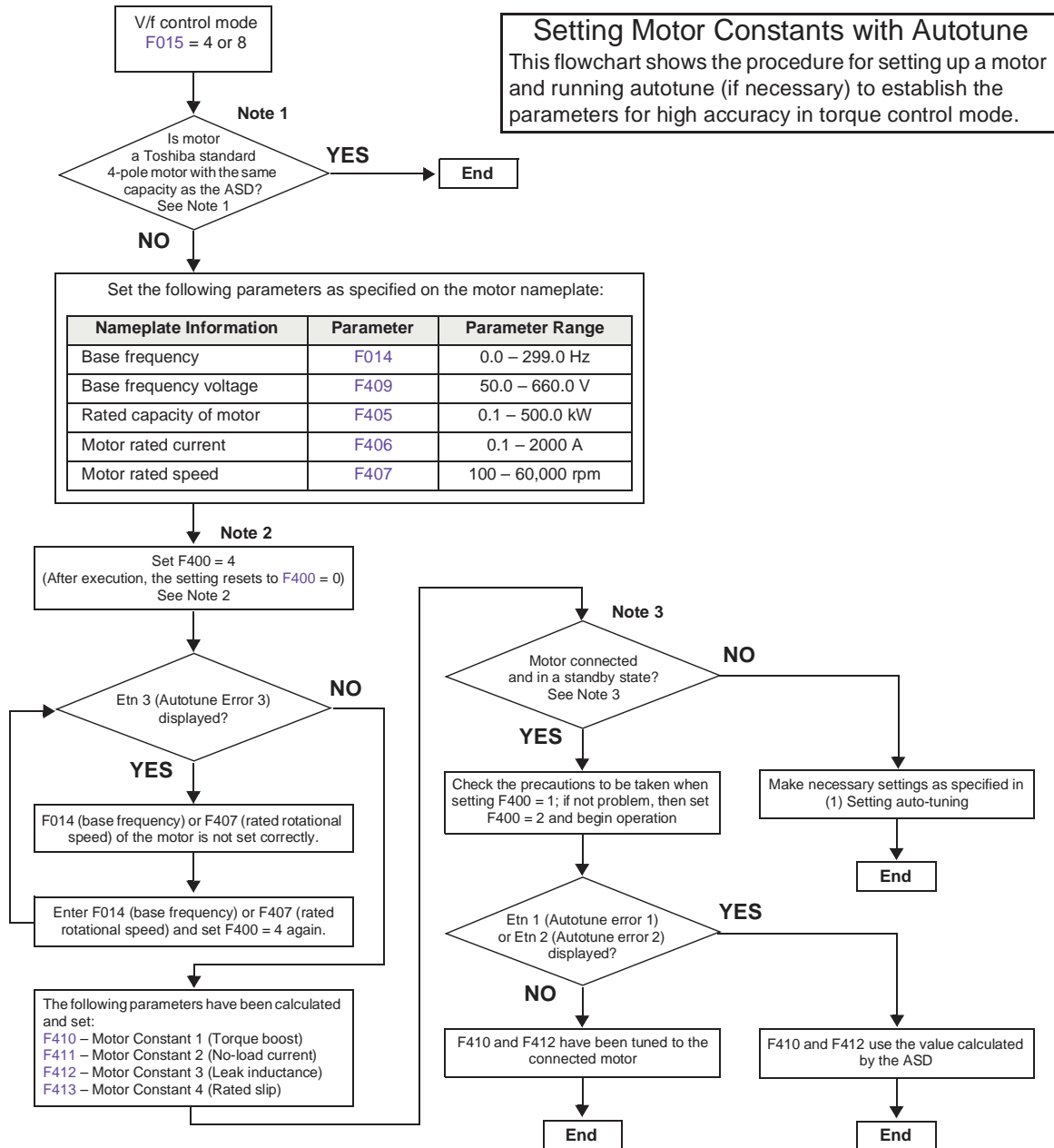
Speed limits can be adjusted by changing the external signals and by specifying the center reference value.

## Setting Motor Constants

For greatest accuracy in torque control mode several motor parameters need to be recorded in the ASD.

These parameters can be entered manually, calculated from basic motor nameplate data, or loaded automatically from pre-programmed Toshiba four-pole motor data.

The flow-chart on page 8 shows how to ensure the necessary parameters are recorded in the ASD memory.



**Note 1:**

Motor used			Tuning required: Yes/No
Type	No. Motor Poles	Capacity	
Toshiba standard motor	4-Pole	Same as ASD	No (Tuned to factory defaults)*
		Different than ASD	Yes
	Other than 4-Pole	Same as ASD	
		Different than ASD	
Others			

\* When using motor cables 100 ft. (30 m) or longer, set F400 (Autotune 1) = 2.

**Note 2:** Motor does not need to be connected.

**Note 3:** Motor is connected but can be loaded or unloaded.



# Torque Control Applications

## Unidirectional Rotation

If a motor rotates in one direction and does not reverse rotation during operation, set **F435 – Rotation in Specified Direction ONLY** to **1: Enabled**.

The direction of rotation of the motor is set by parameter **F008 – Forward/Reverse Run Selection**. Set **F008** to **0: Forward**, or **1: Reverse**, as required by the system.

See the ASD Operation Manual for details of the interaction between **F008 – Forward/Reverse Run Selection** and **F311 – Forward Run/Reverse Run Disable**.

On a paper manufacturing line for example, once the machines have been set up the direction of rotation of their motors is fixed and does not change.

When controlling the operation of the entire system, the torque produced in the desired direction of rotation (direction specified by a rotation command) is considered positive torque and the torque produced opposite of the specified rotation is considered negative torque.

In [Figure 7. on pg. 10](#) motors ASD 1 and 2 drive rolls that rotate to send material in one direction along the manufacturing line.

The direction of rotation of ASD 1 and 2 differ depending on whether they are placed on the top or bottom side of the line they drive. In this case ASD 1 rotates forward, and ASD 2 rotates in reverse.

Torque commands from the host control unit of the system to the ASDs have unified polarity and the direction of rotation of each individual motor is ignored. That is why this setting is usually used for systems that use motors whose directions of rotation remain unchanged.

Figure 6. Unidirectional rotation: F435 – Enabled.

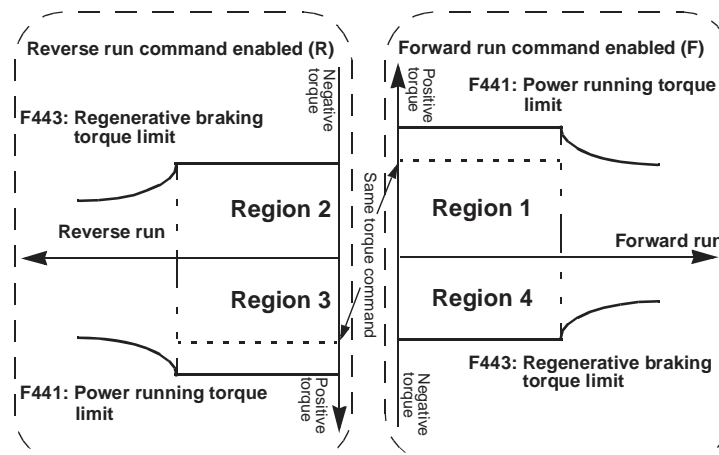
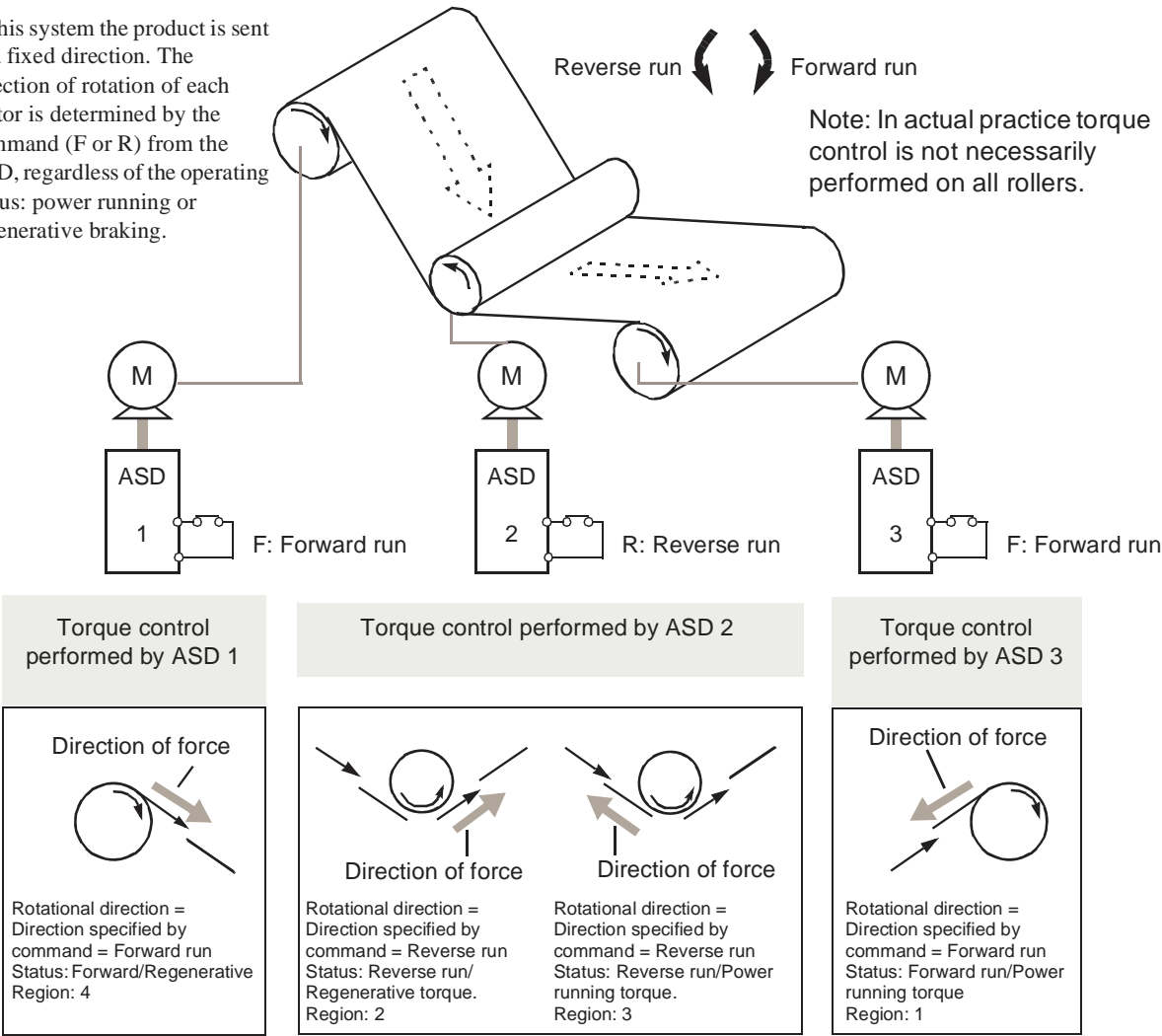


Figure 7. Example of Unidirectional Torque Control.

In this system the product is sent in a fixed direction. The direction of rotation of each motor is determined by the command (F or R) from the ASD, regardless of the operating status: power running or regenerative braking.

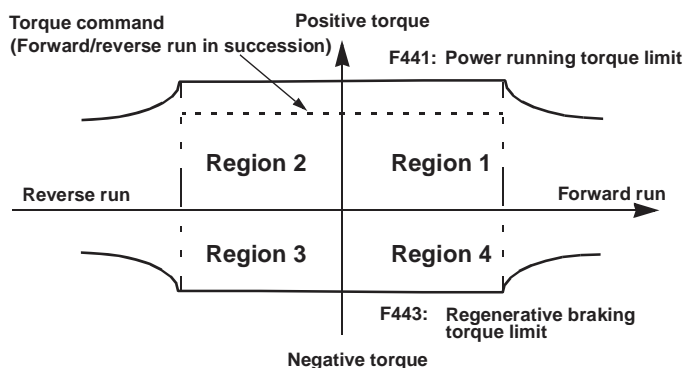


# Bidirectional Rotation

If the direction of rotation of a motor changes while the direction in which the load is applied does not, set parameter **F435 – Rotation In Specified Direction ONLY** to **0 – Disabled**. This disables processing of the settings in **F311 – Forward Run/ Reverse Run Disable**.

Cranes and elevator motors are subjected to the kind of loading resulting in bidirectional rotation.

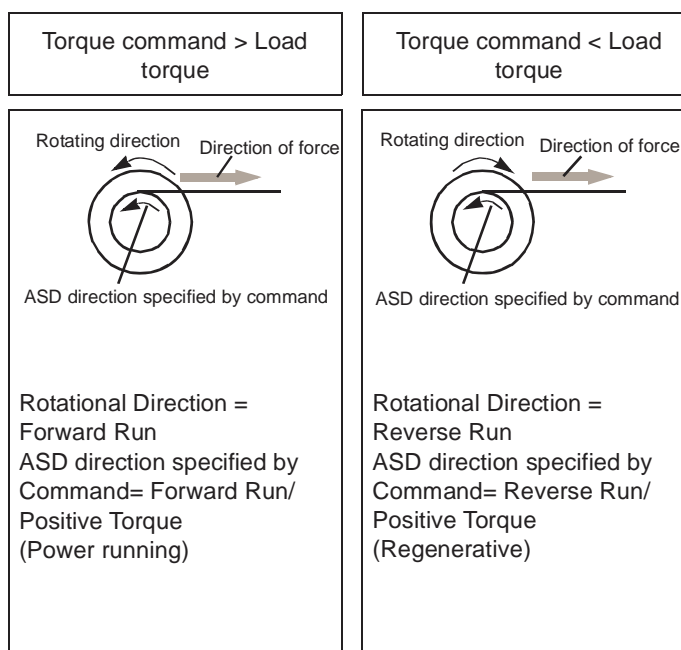
Figure 8. Bidirectional rotation: F435 – Disabled.



This setting is used for controlling a motor whose direction of rotation is determined regardless of the forward or reverse command from the ASD.

Figure 9. Example of Bidirectional Torque Control.

In the system shown here the direction of rotation of the motor, its operating status, will change between power running and regenerative braking according to the process demands.



# Summary: Torque Control Parameters

Below is a summary of torque control and related parameters.

**Table 5. Torque Control and Related Parameters.**

Parameter Number	Parameter Name	Adjustment Range	Default Setting
F004	Frequency Mode 1	1: V/I 2: RR 3: RX 4: Not Used 5: EOI Keypad 6: RS485 7: Communications Option Board 8: RX2 (AI1) 9: Option V/I 10: UP/DOWN Frequency (terminal board) 11: Pulse Input (option) 12: Pulse Input (motor CPU) 13: Binary/BCD Input (option)	2: RR
F011	Maximum Frequency	30.0 – 299.0 Hz	80.0
F012	Upper Limit Frequency	0.0 Hz – F011	60.0
F013	Lower Limit Frequency	0.0 Hz – F012	0.0
F014	Base Frequency 1	0.0 Hz – F012	60.0
F015	V/f Pattern	0: Constant Torque 1: Voltage Decrease Curve 2: Automatic Torque Boost 3: Sensorless Vector Control (Speed) 4: Sensorless Vector Control (Speed/Torque) 5: V/f 5-Point Curve 6: PM Drive 7: PG Feedback Vector Control (Speed) 8: PG Feedback Vector Control (Speed/Torque)	0: Constant Torque
F201	V/I Input Point 1 Setting	0 – 100%	0
F203	V/I Input Point 2 Setting	0 – 100%	100
F205	V/I Input Point 1 Rate	0 – 250%	0
F206	V/I Input Point 2 Rate	0 – 250%	100
F207	Frequency Mode 2	Same as F004 (1 – 13)	1
F210	RR Input Point 1 Setting	0 – 100%	0
F212	RR Input Point 2 Setting	0 – 100%	100
F214	RR Input Point 1 Rate	0 – 250%	0
F215	RR Input Point 2 Rate	0 – 250%	100
F216	RX Input Point 1 Setting	±100%	0
F218	RX Input Point 2 Setting	±100%	100
F220	RX Input Point 2 Rate	±250%	0
F221	RX Input Point 2 Rate	±250%	100
F222	RX2 Input Point 1 Setting	±100%	0
F224	RX2 Input Point 2 Setting	±100%	100
F226	RX2 Input Point 2 Rate	±250%	0.0

Parameter Number	Parameter Name	Adjustment Range	Default Setting
F227	RX2 Input Point 2 Rate	±250%	100
F311	Forward Run/Reverse Run Disable	0: Off 1: Disable Reverse Run 2: Disable Forward Run	0: Off
F400	Autotuning 1	0: Autotune Disabled 1: Reset Motor Defaults 2: Enable Autotune on Run Command 3: Autotuning by Input Terminal Signal 4: Motor Constant Auto-calculation	0: Autotune Disabled
F405	Motor Rated Capacity	0.1 – 500.0 hp	11.0
F406	Motor Rated Current	0.1 – 2000.0 A	20.3
F407	Motor Rated RPM	100 – 60,000 RPM	1730
F409	Base Frequency Voltage 1	50.0 – 660.0 V	ASD Dependant
F410	Motor Constant 1 (Torque Boost)	0.0 – 30.0%	ASD Dependant
F411	Motor Constant2 (No-load Current)	10 – 90%	ASD Dependant
F412	Motor Constant3 (Leak Inductance)	0 – 200%	ASD Dependant
F413	Motor Constant 4 (Rated Slip)	0.01 – 25.00%	ASD Dependant
F420	Torque Command Selection	1: V/I 2: RR 3: RX 4: Panel Keypad 5: RD482 2-Wire 6: RS482 4-Wire 7: Communication Option board 8: RX2 (AI1)	3: RX
F425	Forward Speed Limit Input	0: Disabled 1: V/I 2: RR 3: RX 4: F426	0: Disabled
F426	Forward Speed Limit Level	0.0 Hz – F012	80.0
F427	Reverse Speed Limit Input	0: Disabled 1: V/I 2: RR 3: RX 4: F426	0: Disabled
F428	Reverse Speed Limit Level	0.0 Hz – F012	80.0
F430	Speed Limit Center Value Reference	0: Disabled 1: V/I 2: RR 3: RX 4: F431 Setting	0: Disabled
F431	Speed Limit Center Value	0.0 Hz – F011	0.0
F432	Speed Limit Band	0.0 Hz – F011	0.0
F435	Rotation in Specified Direction Only	0: Disabled 1: Enabled	0: Disabled
F440	Power Running Torque Limit 1	1: V/I 2: RR 3: RX 4: F441 Setting	4: F441

Parameter Number	Parameter Name	Adjustment Range	Default Setting
F441	Power Running Torque Limit 1 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F442	Regenerative Braking Torque Limit 1	1: V/I 2: RR 3: RX 4: F443 Setting	4: F443
F443	Regenerative Braking Torque Limit 1 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F444	Power Running Torque Limit 2 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F445	Regenerative Braking Torque Limit 2 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F446	Power Running Torque Limit 3 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F447	Regenerative Braking Torque Limit 3 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F448	Power Running Torque Limit 4 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F449	Regenerative Braking Torque Limit 4 Level	0.0 – 249.9% 250 (Disabled)	250 (Disabled)
F472	RR Input Bias	0 – 255	128
F473	RR Input Gain	0 – 255	154
F474	RX Input Bias	0 – 255	127
F475	RX Input Gain	0 – 255	127
F476	RX2 Input Bias	0 – 255	128
F477	RX2 Input Gain	0 – 255	128
F725	Panel Torque Command	±250%	0.00
F727	Panel Tension Torque Bias	±250%	0.00

## Parameter Descriptions

**F004 — Frequency Mode 1** specifies the input source for the frequency command.

**F011 — Maximum Frequency** specifies the absolute maximum frequency that the ASD will output. Acceleration/deceleration times are calculated based on this value.

**F012 — Upper Limit Frequency** specifies the highest frequency that the ASD will accept as a frequency command. The ASD may output frequencies higher than **Upper Limit Frequency** (but no higher than **Maximum Frequency**) when operating in PID-, Torque-, or Vector Control mode.

**F013 — Lower Limit Frequency** is the lowest frequency that the ASD will accept as a frequency command or set point. Under certain conditions the ASD may output frequencies lower than the **Lower Limit Frequency**.

- Accelerating from a stop,
- Decelerating to a stop,
- System is in PID-, Torque-, or Vector Control modes

**F014 — Base Frequency 1** is the frequency at which the output voltage of the ASD reaches its maximum setting. The Base Frequency should be set to the frequency listed on the motor nameplate.

**F015 — V/f Pattern** establishes the relationship between the output frequency and the output voltage. See the ASD manual for details.

**F201, F203 — V/I Input Point 1, 2 Setting** sets two points that establish the V/I response slope. The two points typically refer to the lower and upper range limits as a percent of maximum frequency/full-load torque. The use of **F201, F203, F205, and F206** is explained in detail in the ASD Operation Manual.

**F205, F206 — V/I Input Point 1, 2 Rate** is used to set the gain and bias of the V/I input terminal when operating in Torque Control Mode. These parameters set the output torque value associated with Input Point Settings as a percent of full-load torque.

**F207 — Frequency Mode 2** specifies the input source for the frequency command used as Frequency Mode 2.

**F210, F212 — RR Input Point 1, 2 Setting** set the two points that establish the RR response slope. These two settings are entered as a percentage of **F011– Maximum Frequency**. The use of **F210, F212, F214, and F215** is explained in detail in the ASD Operation Manual.

**F214, F215 — RR Input Point 1, 2 Rate** is used to set the gain and bias of the RR input terminal when operating in Torque Control Mode. These parameters set the output torque value associated with Input Point Settings as a percent of full-load torque.

**F216, F218 — RX Input Point 1, 2 Setting** set the two points that establish the RX response slope. These two settings are entered as a percentage of **F011– Maximum Frequency**. The use of **F216, F218, F220, and F221** is explained in detail in the ASD Operation Manual.

**F220, F221 — RX Input Point 1, 2 Rate** is used to set the gain and bias of the RX input terminal when operating in Torque Control Mode. These parameters set the output torque value associated with Input Point Settings as a percent of full-load torque.

**F222, F224 — RX2 Input Point 1, 2 Setting** set the two points that establish the RX2 response slope. These two settings are entered as a percentage of **F011– Maximum Frequency**. The use of **F222, F224, F226, and F227** is explained in detail in the ASD Operation Manual.

**F226, F227 — RX2 Input Point 1, 2 Rate** is used to set the gain and bias of the RX2 input terminal when operating in Torque Control Mode. These parameters set the output torque value associated with Input Point Settings as a percent of full-load torque.

**F311 — Forward Run/Reverse Run Disable** sets the **Forward Run** or **Reverse Run** mode. If **0 – Off** is selected the received direction command will determine the motor rotation.

**F400 — Autotuning 1** sets the autotune command status. See the ASD User Manual for details.

**F405 — Motor Rated Capacity** sets the nameplate rated capacity.

**F406 — Motor Rated Current** sets the nameplate rated current.

**F407 — Motor Rated RPM** sets the nameplate rated motor speed.

**F409 — Base Frequency Voltage 1** is the motor output voltage at **F014 – Base Frequency 1**.

**F410 — Motor Constant 1 (Torque Boost)** sets the primary resistance of the motor. Increasing this value can prevent a drop in motor torque at low speeds.

**F411 — Motor Constant 2 (No-load Current)** specifies the current level required to excite the motor. Specifying a value that is too high may result in erratic motor operation.

**F412 — Motor Constant 3 (Leak Inductance)** sets the leakage inductance of the motor. A higher setting results in a higher output torque at high speeds.

**F413 — Motor Constant 4 (Rated Slip)** sets the secondary resistance of the motor. An increase in this parameter results in an increase in compensation for motor slip.

**F420 — Torque Command Selection** in Torque Control mode allows the user to select the source of the torque command signal.

**F425, F427 — Forward, Reverse Speed Limit Input** enables/disables the **Forward/Reverse Speed Limit Input** control function. When enabled in Torque Control mode, the forward/reverse speed limit is controlled by the selected input.

**F426, F428 — Forward, Reverse Speed Limit Input Level** provides a set value to used as the forward/reverse speed limit settings if **Setting** is selected in **F425** or **F427**.

**F430 — Speed Limit Center Value Reference** selects the input terminal that be used to control the allowable speed variance.

**F431 — Speed Limit Center Value** sets the target speed in Torque Control mode.

**F432 — Speed Limit Band** establish a plus-or-minus bandwidth for the corresponding Speed Limit Center Value in **F431**.

**F435 — Rotation in Specified Direction Only** enables or disables the Forward Run or Reverse Run mode. If either direction is disabled, commands for the disabled direction will not be recognized.

**F440 — Power Running Torque Limit 1** determines the source of the control signal for the positive torque limit settings. If **Settings** is selected, the value set in **F441** is used as the input.

**F441, F444, F446, F448 — Power Running Torque Limit 1 – 4 Level** provides the value of the control signal input for the positive torque upper limit for the #1 – #4 motor profiles if **Settings** is selected.

**F442 — Regenerative Braking Torque Limit 1** determines the source of the control signal for the Regenerative Torque Limit settings. If **Settings** is selected, the value set in **F443** is used as the input.

**F443, F445, F447, F449 — Regenerative Braking Torque Limit 1 – 4 Level** provides the value of the control signal input for the Regenerative Torque Limit for the #1 – #4 motor profiles if **Settings** is selected.

**F472, F474, F476 — RR/RX/RX2 Input Bias** may be used to ensure that the zero level of the input source is also the zero level setting of the ASD system.

**F473, F475, F477 — RR/RX/RX2 Input Gain** may be used to fine tune the gain of the input terminal to ensure that the 100% level of the input source is also the 100% level of the ASD system.

**F725 — Panel Torque Command** sets the torque command when using the LED Keypad option.

**F727 — Panel Tension Torque Bias** sets the torque bias when using the LED Keypad option.







# TOSHIBA

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